

consumers in the 85 markets “left behind” are harmed by the build-out rule far more than consumers in the other 15 markets benefit from the build-out requirement. As expected, the incumbent cable company’s profits are higher in the presence of a build-out rule than free entry (\$113 million to \$94 million).

From our benchmark simulation, we see that build-out rules are bad for consumers and good for incumbents. Moreover, this simulation shows that a build-out rule results in a different form of “economic redlining”—i.e., *the build-out rule has little effect on the incentives of a firm to serve the most-profitable communities but instead causes more marginal communities to be bypassed entirely.*³⁶ In our simulation, the build-out rule caused the entrant to build a network that passed only 25% of the homes than it would have built in the absence of such a rule.

C. Sensitivity to Market Share Assumption

In Table 3, we evaluate the simulation results across a range of market shares for the entrant (the benchmark being 35%). Table 3 shows that the entry-detering effect of a build-out rule is strong even with less-optimistic and more-optimistic market share assumptions. At a 15% market share, the entrant enters all 100 markets and passes 10% of the homes with free entry, on average. If the entrant’s market share rises to 50%, then the entrant passes 79% of homes, on average, in the 100 markets.

Likewise, with higher market shares, the entrant will pass more homes under a build-out rule, though the entrant always passes fewer homes under a build-out rule than under a policy of free entry. Even if the entrant achieves a 50% market share, then the entrant will serve only 65 of the 100 markets. Note that *if the entrant only achieves a market share of less than 35%, then the entrant will fail to enter any market if a build-out rule is imposed.* One recent analyst report predicts that the telecommunications carriers’ market share of video services will be 15%, so the prospect that entry will not occur because of build-out rules—even for large, well-financed firms like the Bells—is genuine.³⁷

³⁶ Red-lining is typically associated with the treatment of different income groups. But, as we illustrate here, partial entry can also be motivated by cost differences even if households do not vary in demand characteristics.

³⁷ See BOA Bell Video Research Brief, *supra* n. 28.

Table 3. Effects of the Entrant's Market Share

Entrant Market Share	Entrant's Share Homes Passed to Total Homes (100,000)		Entrant's Markets Served		Entrant's Investment \$Mil		Consumer Surplus \$Mil		Incumbent's Profits \$Mil	
	Free Entry	Build-out Rule	Free Entry	Build-out Rule	Free Entry	Build-out Rule	Free Entry	Build-out Rule	Free Entry	Build-out Rule
0.20	0.10	0.00	100	0	2	0	63	60	117	120
0.25	0.26	0.00	100	0	7	0	67	60	112	120
0.30	0.43	0.00	100	0	12	0	71	60	104	120
0.35	0.60	0.15	100	15	18	6	75	64	94	113
0.40	0.69	0.36	100	36	22	15	78	69	85	102
0.45	0.75	0.54	100	54	26	23	80	74	76	90
0.50	0.79	0.65	100	65	28	30	81	77	71	79

Notes: Reported results are based on an average of 10 runs of the simulation. Results are rounded.

The entrant's investment is likewise positively related to its market share. What is interesting about the statistics on investment is the relationship between investment in the free entry and build-out scenarios. If the entrant has only a small market share, then investment is higher with free entry. As the entrant's share rises, investment becomes higher in the build-out case. Note, however, that in every case the number of homes passed falls with the build-out rule. Thus, even though investment may be higher, even significantly so, the increased investment does not lead to more service being provided. At a 50% market share for the entrant, it costs more to serve 18% fewer homes under a build-out rule. Clearly, *build-out rules lead to excessive and less productive investment, and are thus socially undesirable.*

The final two headings of Table 3 are the most important for deciphering the "consumer welfare" versus the "incumbent profit" justification for a build-out rule. Observe that consumer surplus under the build-out rule is never larger, and typically much smaller, than consumer surplus with free entry.³⁸ Thus, we

³⁸ It is theoretically possible to get higher consumer surplus with build-out rules, but only under some rather extreme assumptions. Even then, the increase in surplus over the free entry case would be rather small.

find no support here for a consumer justification for build-out requirements. Alternately, the incumbent's profits are always larger with a build-out rule than with free entry. So, the best argument for a build-out rule seems to be the profit motive—i.e., the role of build-out requirements is to protect the profits of the incumbent.

D. Sensitivity to Price Competition Assumption

In the benchmark case, we assumed price was 20% less than the monopoly price if the rival networks completely overlapped (with prices falling linearly between monopoly and 100% overlap). In Table 3, we present the output of the simulation at price cuts ranging from 0% to 50% off monopoly levels at 100% overlap. For all the simulations summarized in Table 4, the entrant is assumed to have a 35% post-entry market share (as in the benchmark case).

Table 4. Effects of the Intensity of Price Competition

Assumed Price Cut at 100% Overlap	Entrant's Homes Passed to Total Homes (100,000)		Entrant Markets Served		Entrant's Investment \$Mil		Consumer Surplus \$Mil		Incumbent's Profits \$Mil	
	Free Entry	Build- out Rule	Free Entry	Build- out Rule	Free Entry	Build- out Rule	Free Entry	Build- out Rule	Free Entry	Build- out Rule
0.00	0.61	0.23	100	23	19	9	60	60	94	110
0.10	0.60	0.21	100	21	19	8	68	63	94	111
0.20	0.60	0.15	100	15	18	6	75	64	94	113
0.30	0.57	0.04	100	4	18	1	83	62	93	118
0.40	0.56	0.00	100	0	17	0	90	60	92	120
0.50	0.53	0.00	100	0	16	0	96	60	91	120

Notes: Reported results are based on an average of 10 runs of the simulation. Results are rounded.

From the table we see that large changes in the price reduction from competition do not have a particularly strong effect on the free entry equilibrium. The percent of homes passed in the free entry equilibrium fall from 61% to 53% as the price cut rises from 0% to 50%, and the entrant's investment remains relatively stable at just under \$20 million. In contrast, the build-out rule is a

much more potent deterrent to entry as price competition intensifies. For example, if the price cut rises from 20% to 30% (a plausible scenario given published estimates of the price effects of cable competition), then the entrant's homes passed fall from 15% to 4% of homes (15 markets to 4 markets).³⁹ The entrant does not enter at all under a build-out rule if the price cut is 40% or larger. The role of the intensity of price competition is detailed in POLICY PAPER No. 21.

While consumer surplus rises with the intensity of price competition in the free entry case, consumer surplus falls toward the monopoly level under a build-out rule with intense price competition. But observe that consumer surplus has a non-linear relationship with the intensity of price competition. At both a 0% and 50% price cut consumer surplus is \$60 million (the monopoly level), and between these two extremes consumer surplus is always larger than \$60 million. The explanation is simple. If entry does not reduce prices (0%), then consumers gain nothing from entry; but if the combination of aggressive pricing and build-out rules deter entry (+40%), then consumers gain nothing. Intermediate ranges of price cuts allow for some entry, and consumers always benefit from price-reducing entry. Since perfect collusion is practically impossible and the evidence weighs against collusive outcomes,⁴⁰ then this simulation reveals that *the only certain method of increasing consumer welfare in video markets is to have entry without build-out rules.*

The relationship of incumbent profits to price competition is also interesting. With a free entry policy, more intense price competition always reduces the incumbent's profits. With a build-out rule, however, the incumbent's profits will rise even if entry would result in intense price competition. While this may seem a bit paradoxical, this apparent anomaly is explained when one recognizes that the prospects for intense price competition serves to retard and deter entry. Stated another way, both the build-out rule and intense price competition work

³⁹ A Government Accountability Office study estimates a 16% differential based on the average overlap of cable rivals, where the average is less than 100%. See GAO, *Direct Broadcast Satellite Subscribership Has Grown Rapidly, but Varies across Different Types of Markets*, Report to the Subcommittee on Antitrust, Competition Policy and Consumer Rights, Committee on the Judiciary, U.S. Senate, US Government Accountability Office, GAO-05-257 (April 2005) ("GAO Report"); Beard, Ford, Hill and Saba, *supra* note 11.

⁴⁰ *Id.*

together to significantly retard entry. With entry sufficiently deterred, the incumbent will never have to reduce its price significantly.⁴¹

Like Tables 2 and 3, the simulation results summarized in Table 4 show that the interests of consumers and incumbents are always in conflict. The fact that both policymakers and incumbents are strong advocates of build-out rules is puzzling, particularly if policymakers are viewed as serving the interests of consumers.

IV. Impact of Build-Out Rules with Defection

Our benchmark simulation above shows that a universal build-out rule has the effect of the entrant bypassing entire communities (77% of the communities in particular). In the current U.S. cable franchise system, build-out requirements are not uniform and many communities have no such requirements. But, for the results summarized in Tables 2 through 4, we have assumed that all markets either have a build-out rule or do not. In reality, some markets will impose the build-out requirement while others will allow for free entry. We can consider the effects of a mix of entry constraints by allowing free entry in some markets while imposing a build-out rule in others.

Communities benefit from defecting from a build-out requirement by increasing their relative attractiveness to entrants. If we assume (plausibly) that the entrant has limited deployment resources, then the entrant will direct its limited resources to their highest-value use.⁴² *As a result, a community can "leap-frog" other communities and make its locality more profitable to the entrant by not imposing a build-out requirements.* We can evaluate how a community may be affected by defection using the simulation.

⁴¹ Cable operators have already signaled to telecom entrants that competition will be intense. See, e.g., *Comcast to Boost Residential Internet Service Speed*, WALL STREET JOURNAL (July 12, 2005) at D4 (reporting that Comcast, the nation's largest cable operator, will automatically begin to upgrade existing subscribers located in Philadelphia, Baltimore, Detroit, New Jersey and Washington, D.C. to six megabits per second for free (or eight megabits per second for an additional \$10) during Summer 2005). Coincidentally, these are the same states where Verizon plans to roll-out its FiOS fiber-to-the home product.

⁴² Note that we are not assuming a capital budget constraint, only that deployment resources such as labor and materials are limited and directed to higher valued uses first.

If we assume, for example, that 25% of the markets do not impose a build-out rule (and the other 75% impose such a requirement), then the average increase in the rank of the “defectors” is 38 places. In other words, a market ranked 50th in terms of profitability with a build-out rule ranks 12th in profitability, on average, if it does not impose a build-out rule. Given that it is the high cost markets that are abandoned by the entrant under a build-out rule, it is these markets that may have the most to gain from this “defection.”

So, in the presence of widespread application of a build-out rule, policymakers (local and state) can increase the probability of their markets being served sooner rather than later by rejecting the requirement for an entrant to serve the entire market.

V. Conclusion

Policymakers have long wished for the nation’s two wireline communications goliaths – the cable and local telephone industries – to compete aggressively for residential consumers over a bundle of voice, video, and data services. The desired outcomes are lower prices that result from head-to-head competition and expanded consumer choice among providers and video line-ups.

That dream is on the brink of becoming a reality. Technological advances and new infrastructure deployment have put the country at the cusp of this inter-modal competition for advanced products and services. Cable companies today are now deploying advanced, Voice over Internet Protocol service that is substantially deregulated and not subject to any build-out commitment. At the same time, telephone companies like Verizon and SBC are aggressively deploying new fiber services, but their ability to sell multichannel video services to residential consumers must pass through a long and torturous local franchise process. There should be no surprise, then, that while cable companies serve over 3.7 million residential consumers with telephone service, incumbent telephone companies only serve a smattering of video customers.⁴³

⁴³ Industry Analysis and Technology Division, Wireline Competition Bureau, FCC, *Local Telephone Competition: Status as of December 31, 2004* (July 2005) at Table 5. In the *Eleventh Cable Competition Report*, the FCC reported that the majority of cable operators offered some form of voice telephone service – in that same report, the FCC observed that telephone company video entry “remains limited”. *Eleventh Annual Cable Competition Report*, *supra* n. 32 at ¶¶ 12, 125.

One aspect of the cable local franchising process is the imposition of "build-out" requirements on new video entrants. Authorities that impose such build-out rules perhaps have the best of intentions, which is to assure that all constituents in their community receive the benefits of competition. But we show in this paper that this is a risky gamble—*i.e., a build-out rule, in fact, creates a tremendous disincentive for a new entrant to invest and is likely to result in entire communities being bypassed.* Our theoretical model shows that a build-out rule will *always* increase costs and reduce profits of the prospective entrant, and our empirical simulations show that the net result is substantially less deployment. In other words, a build-out rule designed to prevent "economic red-lining" *within a community* essentially imposes a different form of "economic red-lining" *between communities.* Further, if entry is deterred by the build-out rule, consumers are denied a price break that they would have otherwise received in the absence of the rule.

APPENDIX A THEORETICAL ANALYSIS

We begin with a simple scenario. Let there be two firms, A and B, and two markets, 1 and 2. Firm A is the incumbent and already has sunk investments in both markets. Firm B is contemplating entry in the markets with sunk costs of K_1 and K_2 (both positive) to enter market 1 and market 2, respectively. There are three possible structures:

- Case 1) Firm A is in both markets 1 and 2 operating as a monopolist charging common price P_A ;
- Case 2) Firm A is in both markets 1 and 2, Firm B is in market 1 only, and prices are P_A and P_B ; and
- Case 3) Firms A and B are in markets 1 and 2 and prices are P_A and P_B .

For simplicity, let the prices (P_A, P_B) be net of incremental cost. The demand curves faced by the two firms in each market are:

$$\text{Firm A: } q_1^A(P_A, P_B), q_2^A(P_A, P_B), \quad (\text{A-1})$$

$$\text{Firm B: } q_1^B(P_B, P_A), q_2^B(P_B, P_A), \quad (\text{A-2})$$

where q_i^j is equal to the subscribers/customers in market i for firm j . Note that each firm charges a uniform price across all markets. For simplicity, let

$$q_2^A(P_A, P_B) = \lambda q_1^A(P_A, P_B), \quad (\text{A-1}')$$

$$q_2^B(P_B, P_A) = \lambda q_1^B(P_B, P_A), \quad (\text{A-2}')$$

where λ is an exogenous, non-negative constant. Numerous factors may determine differences across markets, but those differences are summarized by the parameter λ .

We can now evaluate equilibria under our three possible outcomes. Equilibria are determined under the following assumptions: (a) prices are determined under simultaneous, non-cooperative, one-shot pricing; (b) products are differentiated; (c) firm own-demand elasticities decrease (become more

elastic) as own prices rises, and increase (become less elastic) as the rival's price rises; and (d) equilibria exist and are unique.

Case 1 Equilibrium:

For Case 1, Firm A operates alone in both markets 1 and 2; Firm B does not offer services. The profit function for A is

$$\pi^A = P_A(1 + \lambda)q_1^A(P_A, \infty), \quad (\text{A-3})$$

where π is profit. The first order condition for firm A is

$$1 + \xi^A(P_A, \infty) = 0, \quad (\text{A-4})$$

where ξ^A is the own price elasticity of demand. Equation (A-4) is the first-order condition for a monopolist. Let \bar{P}_A be the monopoly price.

Case 2 Equilibrium:

For Case 2, Firm A operates alone in market 2, but competes with Firm B for customers in market 1. The profit function for A is

$$\pi^A = P_A q_1^A(P_A, P_B) + \lambda P_A q_1^A(P_A, \infty), \quad (\text{A-5})$$

where π is profit. The first order condition for firm A can be written as

$$[1 + \xi^A(P_A, P_B)] + \lambda[1 + \xi^A(P_A, \infty)] = 0. \quad (\text{A-6})$$

From Equation (A-6), the reaction function of firm A is derived. If P_A rises when P_B rises ($\partial P_A^* / \partial P_B > 0$), which is a sensible expectation and our assumption, then the reaction function is upward sloping. Note that P_A and P_B are strategic complements. Further, ($\partial P_A^* / \partial \lambda > 0$), which can be shown by calculus.⁴⁴

⁴⁴ See Beard, et al. (2005), *supra* n. 11, for a detailed exposition on this point.

Firm B is now active in market 1, and his first-order condition can be written as

$$1 + \xi^B(P_A, P_B) = 0. \quad (\text{A-7})$$

As with Firm A, we have $(\partial P_B^* / \partial P_A > 0)$, but note that $(\partial P_B^* / \partial \lambda = 0)$ so that P_B^* depends on λ only indirectly through P_A .

In this case, the equilibrium prices are (P_A^*, P_B^*) , and it can be shown that $(\bar{P}_A > P_A^*)$. In other words, Firm A's price falls when B enters market 1. The proof is straightforward. For $P_B < \infty$, we have

$$1 + \xi^A(P_A, P_B) < 1 + \xi^A(P_A, \infty), \quad (\text{A-8})$$

and we know that

$$1 + \xi^A(\bar{P}_A, \infty) = 0. \quad (\text{A-9})$$

For $\lambda > 0$, we must have

$$1 + \xi^A(P_A^*, P_B^*) < 0 < 1 + \xi^A(P_A^*, \infty), \quad (\text{A-10})$$

so we know that $(\bar{P}_A > P_A^*)$, since $\xi^A(\bar{P}_A, \infty)$ is declining in P_A .

Case 3 Equilibrium:

In the final case, Firm B enters both markets. The first order conditions yield

$$1 + \xi^A(P_A, P_B) = 0, \quad (\text{A-11})$$

for Firm A, and

$$1 + \xi^B(P_A, P_B) = 0. \quad (\text{A-12})$$

for Firm B.

Lemma #1. When B enters both markets, the equilibrium prices are $(\tilde{P}_A, \tilde{P}_B)$, whereas when B entered only market 1 prices were (P_A^*, P_B^*) . Then, $(P_A^*, P_B^*) \neq (\tilde{P}_A, \tilde{P}_B)$.

Proof. Assume that the prices are equal. Then, we have

$$1 + \xi^A(P_A^*, P_B^*) = 1 + \xi^A(\tilde{P}_A, \tilde{P}_B) = 0. \quad (\text{A-13})$$

But we also have

$$1 + \xi^A(P_A, \infty) = 0, \quad (\text{A-14})$$

which cannot be true since

$$1 + \xi^A(P_A^*, \infty) > 1 + \xi^A(P_A, P_B^*). \quad (\text{A-15})$$

QED.

Lemma #2. We have either

$$P_A^* > \tilde{P}_A \quad \text{and} \quad P_B^* > \tilde{P}_B, \quad \text{or} \quad (\text{A-16})$$

$$P_A^* < \tilde{P}_A \quad \text{and} \quad P_B^* < \tilde{P}_B. \quad (\text{A-17})$$

Proof. Obvious based on derivatives.

We now turn to the main result on prices. We have

Result:

$$\tilde{P}_A < P_A^*, \quad (\text{A-18})$$

$$\tilde{P}_B < P_B^*. \quad (\text{A-19})$$

Proof. The proof comes from the following: (a) assume equilibria are unique; (b) recall that $(\partial P_A^* / \partial \lambda > 0)$ and the reaction function of B is upward sloping; and (c)

notice that $\tilde{P}_A = P_A^*$ and $\tilde{P}_B < P_B^*$ when $\lambda = 0$. Start at $\lambda = 0$ and let λ rise; both (P_A^*, P_B^*) rise above $(\tilde{P}_A, \tilde{P}_B)$, which do not depend on λ . Other proofs are possible.

Application:

From the above analysis, we see that

$$\bar{P}_A > P_A^* > \tilde{P}_A \quad (\text{A-19})$$

and

$$\bar{P}_B = \infty > P_B^* > \tilde{P}_B. \quad (\text{A-20})$$

This ordering of prices implies

$$\pi_B(\bar{P}_A, \infty) > \pi_B(P_A^*, P_B^*) > \pi_B(\tilde{P}_A, \tilde{P}_B). \quad (\text{A-21})$$

where π is gross (or variable) profit. In all, for Firm B, the net profit order depends on K_1 and K_2 . Firm B will enter both markets if

$$\pi_B(\tilde{P}_A, \tilde{P}_B) - K_1 - K_2 > 0, \quad (\text{A-22})$$

and will enter only market 1 if

$$\pi_B(P_A^*, P_B^*) - K_1 > 0, \text{ and} \quad (\text{A-23})$$

$$\pi_B(\tilde{P}_A, \tilde{P}_B) - K_1 - K_2 < 0. \quad (\text{A-24})$$

In this latter case, a rule requiring that Firm B enter both markets would lead to no entry, whereas the absence of such a rule results in B's entry to market 1.

APPENDIX B A SIMULATION OF SEQUENTIAL ENTRY

In this Appendix, we describe the details of the simulation of sequential entry. The simulation is programmed and run using the statistical software package Eviews 5.1 (www.eviews.com). A spreadsheet could be used, but the simulation would be exceedingly slow and clumsy given the large number of calculations and random numbers generated for the simulation.

There are four fundamental components of the simulation: (a) demand; (b) costs; (c) entry decision; and (d) defection. We describe each in turn, though the first three are jointly determined to some extent.

Demand:

The demand curve in all markets is identical. In each market, we have uniformly distributed reservation prices between \$4800 and \$0. Since marginal costs are zero, the monopoly price is \$2400, where the own-price demand elasticity is -1.0 and market penetration (homes buying divided by homes passed) is 50%. The demand curve is

$$p = 4800 - 4800q \quad (B-1)$$

where p is price and q is the penetration rate ($0 \leq q \leq 1$). The demand curve is calibrated so that the average sale price of cable system would be, on average, approximately \$1200 per home-passed, which is consistent with industry statistics.⁴⁵

Prices are uniform across the market and across the incumbent and entrant. Market price falls as the entrant passes more homes (i.e., overlap), and q rises as p falls as indicated by the demand curve. We assume a benchmark price reduction from monopoly to 100% overlap of 20%.⁴⁶

⁴⁵ Eleventh Annual Cable Competition Report, *supra* n. 32 at Table 5.

⁴⁶ GAO Report, *supra* n. 39.

Consumer surplus in each market is calculated as $(4800 - p^*)q^*/2$, where (p^*, q^*) are the relevant equilibrium quantities. Monopoly profits in each market are simply $2400 \cdot 0.5 \cdot 1000 = 1.2\text{M}$, or \$120M across all 100 simulated markets.

Costs:

Entry costs are computed for each home in each market using the function

$$e'_{i,m} = A \exp(1 + r_{i,m} \cdot s_m) \quad (\text{B-2})$$

where $e'_{i,m}$ is the capital entry costs for home i in market m , A is constant, r is a standard normal random variable unique for each home, and s is scale parameter unique to each market. The constant A is set so that the average cost per home passed across all markets is \$600, which is consistent with industry statistics. Equation (B-2) renders variation both within and across markets, with r determining within market variation and s determining across market variation.

The scale parameter s is set such that values of $0.5 \leq s \leq 1.5$ occur in about two-thirds of the simulated markets, where this range was based on an evaluation of the distribution of loop costs across census block groups using the HAI 5.0 TELRIC cost model. The range for s was determined by estimating the following regression for a number of states:

$$\ln L = \beta_0 + \beta_1 R + \varepsilon \quad (\text{B-3})$$

where L is *ordered* loop costs and R is an *ordered* standard normal random variable. The estimated coefficient β_1 is an estimate of s , and we found that the estimated parameter typically fell between 0.50 and 1.5. We do allow for more extreme values in about one-third of the simulated markets, so costs are allowed to be very low with little variation to favor a finding of pro-consumer build-out mandates.

We can interpret the term $[1 + \exp(r \cdot s)]$ as market density, where costs are a direct function of density. Research shows that population density is approximately lognormal, which explains our choice of functional form.

Entry:

A home is passed if

$$E(d') > e' \quad (B-4)$$

where $E(d')$ is the expected marginal gross profit per home passed and e' is the entry costs for the home. Expected gross revenues for the entrant are simply the market price multiplied by the product of the entrant's market share and the aggregate market penetration. With a build-out requirement, the entrant serves the entire market if the entrant's gross profits at 100% overlap exceeds the sum of e' for the market. Investment is simply the sum of per-home capital costs for whatever number of homes the entrant chooses to serve or is forced to serve under the build-out requirement.

Defection:

The change in profit rank from defection is easily computed. First, we assign a rank to the build-out profit for each market. We then select f markets for defection, and replace the build-out profit for each of the f markets with their respective free entry profits. We then re-rank the profits and compute the mean change in rank.

ADDENDUM (July 20, 2005)

This POLICY PAPER was initially released on July 19, 2005. We since found an error in the simulation related to the computation of the value of a monopoly system. Since this value was an important calibration point for the simulation, we re-ran all the simulations using the correct calculation. The changes to the initial document are only in the tables and discussion thereof, and in Appendix B (in the *Demand* section). The error in the simulation produced too much entry in the build-out case, since the error led to an over-valuation of the monopoly system (i.e., a larger demand for service).

ADDENDUM (January 4, 2007)

Figure 1 and the companion text were altered for consistency with the theoretical exposition and simulation calculations. For better exposition, we also changed some text and notation in Appendix B to match the theoretical discussion in the paper and to eliminate some notational and calculation ambiguities.